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ABSTRACT

This study examined the ability of a newly developed computerized visual vigilance measure, the Preschool Vigilance Task (PVT), to differentiate between 20 hyperactive and 20 control preschoolers. The PVT was developed to minimize cognitive requirements in a vigilance measure. The study compared performance of the subjects on the PVT and the established Continuous Performance Task (CPT) on two separate occasions. Results indicated that both the PVT and CPT were useful in differentiating between hyperactive and control preschoolers. Discriminant analyses revealed that for all combinations of data, the PVT produced significantly higher percentages of correct group classification than did the CPT. The PVT is seen to have potential in the identification of preschool children with Attention-Deficit-Hyperactivity Disorder. The PVT involves only simple computer software and can be administered by minimally trained nonprofessional personnel in approximately 20 minutes. Includes 16 references. (DB)

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DISCRIMINATING BETWEEN HYPERACTIVE AND CONTROL PRESCHOOLERS: THE PRESCHOOL VIGILANCE TASK

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ABSTRACT

A need exists for an objective measure of Attention Deficit-Hyperactivity Disorder (hyperactivity) in the preschool-age population since early recognition and intervention may potentiate a more optimistic prognosis. The purpose of the current study was to examine the ability of a newly developed computerized visual vigilance task [Preschool Vigilance Task (PVT)] to differentiate between hyperactive and control preschoolers. The PVT was hypothesized to be an improvement over well-established visual vigilance tasks such as the Continuous Performance Task (CPT) in terms of its utility with the preschool-age population because of its lack of a cognitive confound.

Hyperactive and control preschoolers were tested on the PVT and CPT on two separate occasions. Results indicate that both the PVT and CPT are useful in differentiating between hyperactive and control preschoolers. Discriminant analyses revealed that for all combinations of data, the PVT produced significantly higher percentages of correct group classification than the CPT. Implications for potential use of the PVT by pediatricians and mental health professionals, as well as future research directions are discussed.

INTRODUCTION

Attention Deficit-Hyperactivity Disorder (AD-HD), or "hyperactivity" as it is commonly called, is perhaps the most widely studied childhood psychological disorder (Barkley, 1982; Pelham, 1982), and is characterized by developmentally inappropriate levels of inattention, impulsiveness, and hyperactivity. It is generally believed to occur in about 3 to 5% of the school-age population in the United States (Barkley, 1983; Pelham, 1982). Although this disorder has been widely studied in the school-age population, there is a paucity of research conducted on preschool-age children where rates are believed to be as high as 14% to 20% among preschool boys and 6% among preschool girls (Campbell, 1985).

In Campbell's 1985 review of hyperactivity in preschoolers, she called for further research in the area of diagnosis. Currently the child is often evaluated solely by a parent and perhaps a preschool teacher and this evaluation is often greatly influenced by the amount of disruption and stress caused by the child in the family or classroom (often referred to as the child's "nuisance value"), therefore the need for an objective measure is obvious.

Visual vigilance was selected as an objective measure of attentional ability. Kupietz and Richardson (1978) have demonstrated that vigilance performance is directly related to attentiveness in the classroom setting and is not merely a laboratory phenomenon. Several studies have clearly shown that

school-age hyperactive children's ability to sustain attention on visual vigilance tasks is deficient when compared to that of control children (Michael, Klorman, Salzman, Borgstedt, & Dainer, 1981; O'Dougherty, Neuchterlein, & Drew, 1984; Rapport, DuPaul, Stoner, & Jones, 1986; Sykes, Douglas, & Morganstern, 1972, 1973; Zentall, 1986).

Continuous Performance Task

The Continuous Performance Task or CPT (Rosvold, Mirsky, Sarason, Bransome, & Beck, 1956) is reportedly the most commonly used method of assessing vigilance in children with suspected attentional deficits (Klee & Garfinkel, 1983; Rapport et al., 1986; Barkley, 1988). O'Dougherty and her colleagues (1984) have cautioned that the CPT may not be appropriate for the preschool age population because of its reliance on a working knowledge of numbers or letters and may penalize these children and introduce an unwanted cognitive confound.

Preschool Vigilance Task

In 1980 Herman, Streissguth, and Little developed a manual vigilance task for preschoolers which was free of the cognitive components found in the CPT. This group of researchers as well as Streissguth and her associates in 1984 demonstrated that this task could reliably detect attentional differences in preschoolers. We have used a modification of their task.

Purpose

The goal of the present study was to examine the ability of our new school Vigilance Task, or PVT, to differentiate between hyperactive and control preschoolers, and to attempt to compare it with the CPT for use with preschoolers.

Method

Subjects

Twenty hyperactive children (17 boys, 3 girls) and twenty control children (17 boys, 3 girls) between the ages of four and six were recruited for this investigation. Children were grouped according to scores on the Conner's Teacher and Parent Rating Scales-Revised. Children in both groups were matched on both age and gender.

Testing Sessions

Parents and preschool teachers were administered the Conner's scales prior to testing the child. Experimenters were blind to the scores on these measures and the classification of the children. All subjects were tested on both the CPT and the PVT on two separate occasions, with at least one week elapsing between the time of the first and second visit. The order of task administration for a particular subject was kept constant across both testing sessions so that the test-retest reliability of this measure could be assessed.

Each child was seated in front of an Apple IIe computer monitor with a response button fastened to the table next to the monitor.

The CPT used in this study presented a series of 12 letters in a randomized serial order, and the subject was instructed to press the response button when and only when he or she saw the letter X. Pretesting insured that they understood the instructions and were able to distinguish between the various letters. For the PVT, a picture of a tree appeared on the monitor and remained there throughout the duration of the task. A bird appeared at intermittent intervals on one extended branch of the tree, and the children were instructed to press the response button when and only when they saw the bird. For both tasks the computer controlled the presentation of the stimuli as well as recorded errors of commission (responses made when the critical stimulus was not displayed), errors of omission (the absence of a response to the occurrence of the critical stimulus), and reaction time (speed of responses which occurred after the appearance of the critical stimulus). See Figure 1 for relevant task information.

Insert Figure 1 about here

RESULTS

Preliminary Analyses

A series of preliminary analyses of variance were conducted to determine whether subjects' performance differed significantly across age groups. Based on the lack of significant differences

between the three age groups, all of the subsequent analyses were conducted with subjects collapsed across age.

Primary Analyses

CPT and PVT Main Effects

A series of repeated measures analyses of variance were conducted on the following dependent measures: errors of commission, errors of omission, and reaction time (see Table 1). There were significant main effects for group on both the CPT and PVT measures of errors of commission and errors of omission, but no significant effects for reaction time. Examination of group means revealed that hyperactive children committed more errors of commission and errors of omission than control children.

Insert Table 1 about here

CPT and PVT Discriminant Analyses

In order to determine the discriminative abilities of the CPT and PVT a series of Linear Discriminant Analyses for two groups were conducted. These were performed using various combinations of data in an attempt to find the optimal discriminative functions. Only those analyses which produced functions with the highest discriminative power will be reported (see Table 2).

Insert Table 2 about here

Discriminant Analyses Combining All Data. The discriminant analysis which produced the function with the most accurate discrimination used all three types of PVT data (errors of commission, errors of omission, and reaction time) gathered during both the first and second session. Using this function 90.0% of control children were correctly identified and 80.0% of hyperactive children were correctly identified. This produced an overall correct classification rate (hyperactive and control) for the PVT of 85.0%. Using the same variables on the CPT, 88.9% of control children were correctly classified and 68.4% of hyperactive children were correctly classified. Thus, the CPT produced an overall correct classification rate of 78.4%.

Discriminant Analyses Using Select Data. Examination of the functions produced by the most accurate discriminant analyses revealed that the factor that contributed the most toward the determination of group membership was errors of omission. Therefore, additional discriminant analyses were conducted using various combinations of the errors of omission data. These analyses revealed that using these data from both sessions combined on the CPT correctly identified 83.3% of control children and 63.2% of hyperactive children, producing an overall correct classification

rate of 73.0%. On the PVT, using only errors of omission data correctly identified 90% of controls and 75% of hyperactives, resulting in an overall correct classification rate of 82.5%. A series of z-tests were conducted on the correct classification rates using all of the data versus using only the errors of omission data. For all of the rates reported here, there were no statistically significant differences between using all of the data and using only omission data.

An analysis of variance was conducted on the correct classification rates for both tasks across all combinations of data and revealed a significant main effect for task (CPT vs. PVT). A Tukey's post-hoc multiple comparison of groups revealed that across all groups of data, the PVT correctly classified more subjects than the CPT ($F = 45.53$, $p = .0001$--PVT mean = 83.75; CPT mean = 70.79).

A caution is warranted in interpreting the findings of the discriminant function analyses. These tests were conducted using a sample which included 50% hyperactive children and 50% control children. Therefore the discriminant functions produced are based on a prior probability that hyperactivity will occur 50% of the time. The base rate of preschool hyperactivity in the general population is much lower, therefore the discriminant functions produced would need to be tested using a random sample of preschoolers from the general population to get a true judgement of their efficiency in identifying hyperactive and control children.

Test-Retest Reliability

In order to determine the test-retest reliability of the various CPT and PVT measures, a series of Pearson product-moment correlations were conducted. On the PVT, errors of omission demonstrated the highest reliability (r = .80, p = .0001). Errors of commission (r = .06, p = .7103) and reaction time (r = .17, p = .2900) did not produce significant test-retest reliability on the PVT. On the CPT, errors of commission demonstrated the highest reliability (r = .75, p = .0001), with errors of omission also revealing a significant correlation (r = .55, p = .0004). Reaction time (r = .16, p = .3461) did not produce significant test retest reliability on the CPT. Overall, the highest test-retest reliability was found on the PVT errors of omission (r = .80) followed by the CPT errors of commission (r = .75).

DISCUSSION

Future Directions and Implications

The current study reveals that the PVT has potential as a useful assessment/detection device for hyperactive preschoolers. It was shown to correctly identify a higher percentage of hyperactive and control children than the well-established CPT. The PVT errors of omission is the most accurate and reliable component of the PVT for identifying hyperactive preschoolers. This measure appears to be assessing the child's attentional ability in a relatively raw form without the addition of possible cognitive confounds, a problem

which may be found in the CPT. Before clinical usage can be advocated, though, more research must be conducted on the PVT.

Future Utility and Research

Once normative and standardization studies have been conducted on the PVT, future utility issues and implications can be addressed. This device could be used to detect children who may need to receive further assessment to determine the presence of an Attention Deficit-Hyperactivity Disorder (AD-HD) by non-clinical personnel, or it could be used by the professional as an objective component of a multi-factorial assessment protocol for the diagnosis of this disorder. An advantage in using the PVT is that it is on simplistic computer software that would enable nonprofessional personnel to easily administer the task to children in a relatively short amount of time (approximately 20 minutes) with a relatively brief amount of training.

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Table 1

Main Effects For Group (Hyperactives vs. Controls)

	F	p	HYPERACTIVE MEAN	HYPERACTIVE S.D.	CONTROL MEAN	CONTROL S.D.
CPT						
OM	10.65	.0024	18.53	18.66	5.17	6.73
COM	11.52	.0017	20.00	30.30	2.78	2.51
RT	0.60	.4436	70.89	26.02	93.33	99.11
PVT						
OM	49.58	.0000	22.90	13.17	4.30	3.81
COM	10.63	.0024	76.00	175.85	2.70	2.77
RT	.07	.7929	210.10	26.02	205.50	67.91

Note. OM = errors of omission, COM = errors of commission, RT = reaction time (in seconds).

Table 2

Discriminant Analyses: Percentage of Correct Classification

	CONTROL	HYPERACTIVES	OVERALL
CPT			
All Data (both sessions)	38.9%	68.4%	78.4%
Errors of Omission (both sessions)	83.3%	63.2%	73.0%
PVT			
All Data (both sessions)	90.0%	80.0%	85.0%
Errors of Omission (both sessions)	90.0%	75.0%	82.5%

Figure 1
Task Information

CPT: stimulus presentation = .2 sec
interstimulus interval = 1.5 sec
number of stimuli = 200 total (30 targets, 20 test)
task duration = 6 min, 20 sec
letters = A,C,E,F,G,H,I,L,S,T,U,X

PVT: stimulus presentation = .5 sec
interstimulus interval = 10 to 60 sec
number of stimuli = 25
task duration = 14.5 min